Atty. Docket No. 002187 USA C03/PDC/WF/DB
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Express Mail No. EL054550261US

David ALUMOT et al.

Rule 53(b) Continuation of
U.S. Application No. 09/298,501

Filed: Concurrently herewith

For: OPTICAL INSPECTION APPARATUS FOR DEFECT DETECTION (as amended)

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Prior to initial examination on the merits and prior to calculation of the filing fee, please amend the above-identified application as follows.

IN THE TITLE:

Please delete the present title and replace it with the following new title: **--OPTICAL INSPECTION APPARATUS FOR DEFECT DETECTION--.**

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 2, please delete the fourth full paragraph, and replace it with the following new paragraph:

According to one aspect of the present invention, there is provided a method of inspecting the surface of an article for defects by: optically examining, in a first phase examination, the complete surface of the article and electrically outputting information indicating

locations on the article suspected of having defects; storing the suspected locations in a storage device; and, in a second phase examination, optically examining with high resolution only the suspected locations of the article's surface for determining the presence or absence of a defect in the suspected locations; characterized in that the first phase examination is effected by optically scanning the complete surface of the article at a high speed with an optical beam of small diameter. Thus, by selecting the diameter of the optical beam used in the first phase examination, the first phase examination may be made at any desired resolution, as compared to the second phase examination, according to the particular application.

Page 2, please delete the fifth full paragraph, and replace it with the following new paragraph:

According to further features of the invention, the first examining phase is effected by optically scanning the complete article surface to be inspected with a laser beam of small diameter; and the second examining phase is automatically effected immediately after the first phase by imaging only the suspected locations on an image converter which converts the images to electrical signals and then analyzes the electrical signals.

Pages 2-3, please delete the paragraph bridging these two pages, and replace it with the following new paragraph:

According to still further features in preferred embodiments of the invention described below, the surface of the article to be inspected includes a pattern, e.g., a patterned wafer used for producing a plurality of integrated-circuit dies or chips. The first examination phase is effected by making a comparison between the inspected pattern and another pattern, serving as a reference pattern, to identify locations on the inspected pattern wherein there are sufficient differences with respect to the reference pattern to indicate a high probability of a defect in the inspected pattern. The second examination phase is also effected by making a comparison between the inspected pattern and the reference pattern, to identify locations on the inspected pattern wherein the comparison shows sufficient differences with respect to the reference pattern to indicate the presence of a defect in the suspected location of the inspected pattern.

Page 3, please delete the second full paragraph, and replace it with the following new paragraph:

It will thus be seen that the novel method of the present invention primarily monitors changes in the defect density while maintaining a high throughput with a relatively low false alarm rate. Thus, the first examination is done at a relatively high speed and with a relatively low spatial resolution such as with a laser beam of small diameter to indicate only suspected locations having a high probability of a defect; and the second examination is done with a

relatively high spatial resolution but only with respect to the suspected locations having a high probability of a defect. The sensitivity of the two phases may be adjusted according to the requirements for any particular application. Thus, where the application involves a relatively low number of defects, the sensitivity of the first examination phase may be increased by using a very small diameter laser beam to detect very small defects at a high speed but at the expense of an increased false alarm rate. However, since only relatively few suspected locations are examined in the second phase, the overall inspection can be effected relatively quickly to enable the fabrication personnel to identify defects caused by any process or equipment, and to immediately correct the cause for such defects.

Page 3, please delete the third full paragraph, and replace it with the following new paragraph:

According to a further feature of the invention, the first examining phase is effected by generating a first flow of N different streams of data representing the pixels of different views of the inspected pattern unit; generating a second flow of N different streams of data representing the pixels of different views of the reference; and comparing the data of the first flow with the data of the second flow to provide an indication of the suspected locations of the inspected surface of the article having a high probability of a defect.

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IN THE CLAIMS

Please cancel claims 1-95.

Please add the following new claims:

96. (New) An apparatus for inspection of a substrate, said apparatus comprising:

an illumination source illuminating said substrate;

first collection optics receiving light and outputting inspection signals;

a comparator calculating a difference between said inspection signals and a reference signal to identify locations on said substrate suspected of having defects thereupon based on a threshold, and outputting suspect location data;

second collection optics receiving light and outputting images according to said suspect location data; and

a defect classifier receiving and classifying said images.

97. (New) The apparatus of claim 96, wherein said illumination source is a laser.

98. (New) The apparatus of claim 96, wherein said first collection optics comprises a plurality of sensors.

99. (New) The apparatus of claim 98, wherein said first collection optics further comprises dark field collection optics.

100. (New) The apparatus of claim 96, wherein said second collection optics comprises an imaging sensor.

101. (New) The apparatus of claim 100, wherein said second collection optics further comprises bright field collection optics.

102. (New) The apparatus of claim 99, wherein said dark field collection optics includes a turret carrying a plurality of objectives thereupon.

103. (New) The apparatus of claim 101, wherein said bright field collection optics includes a turret carrying a plurality of objectives thereupon.

104. (New) The apparatus of claim 96, further comprising an image processor receiving an output of said image sensor and outputting said images.

105. (New) The apparatus of claim 96, wherein said threshold is an adaptive threshold.

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REMARKS

The foregoing amendments have been made to place the application in better form for examination, to provide for internal consistency and to more clearly define the invention. Early, favorable consideration on the merits is respectfully requested.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title is changed as follows:

OPTICAL INSPECTION [METHOD AND] APPARATUS FOR DEFECT DETECTION

IN THE SPECIFICATION:

Page 2, please amend the fourth full paragraph as follows:

According to one aspect of the present invention, there is provided a method of inspecting the surface of [articles] an article for defects[, comprising] by: [placing the article to be inspected on a table; in a first phase,] optically examining, in a first phase examination, the complete surface of the article [on the table at a relatively high speed and with a relatively low spatial resolution;] and electrically outputting information indicating [suspected] locations on the article suspected of having [a high probability of a defect] defects; storing the [outputted information] suspected locations in a storage device; and, in a second phase examination, [while the article is still on the table,] optically examining with [a relatively] high [spatial] resolution only the suspected locations of the article's surface for determining the presence of or absence of a defect in the suspected locations; characterized in that the first phase examination is effected by optically scanning the complete surface of the article at a high speed with an optical beam of

small diameter. Thus, by selecting the diameter of the optical beam used in the first phase examination, the first phase examination may be made at any desired resolution, as compared to the second phase examination, according to the particular application [stored in the storage device for the presence or absence of a defect in the suspected locations].

Page 2, please amend the fifth full paragraph as follows:

According to further features of the invention, the first examining phase is effected by optically scanning the complete article surface to be inspected with a laser beam of small diameter; and the second examining phase is automatically effected immediately after the first phase by imaging only the suspected locations on [a] an image converter which converts the images to electrical signals and then analyzes the electrical signals.

Please amend the paragraph bridging pages 2-3 as follows:

According to still further features in preferred embodiments of the invention described below, the surface of the article to be inspected includes a pattern, e.g., a patterned wafer used for producing a plurality of integrated-circuit dies or chips. The first [examining] examination phase is effected by making a comparison between the inspected pattern and another pattern, serving as a reference pattern, to identify locations on the inspected pattern wherein there are sufficient differences with respect to the reference pattern to indicate a high probability of a defect in the inspected pattern. The second [examining] examination phase is also effected by

making a comparison between the inspected pattern and the reference pattern, to identify locations on the inspected pattern wherein the comparison shows sufficient differences with respect to the reference pattern to indicate the presence of a defect in the suspected location of the inspected pattern.

Page 3, please amend the second full paragraph as follows:

It will thus be seen that the novel method of the present invention primarily monitors changes in the defect density while maintaining a high throughput with a relatively low false alarm rate. Thus, the first examination is done at a relatively high speed and with a relatively low spatial resolution such as with a laser beam of small diameter to indicate only suspected locations having a high probability of a defect; and the second examination is done with a relatively high spatial resolution but only with respect to the suspected locations having a high probability of a defect. The sensitivity of the two phases may be adjusted according to the requirements for any particular application. Thus, where the application involves a relatively low number of defects, the sensitivity of the first examination phase may be increased by using a very small diameter laser beam to detect very small defects at a high speed but at the expense of an increased false alarm rate. However, since only relatively few suspected locations are examined in the second phase, the overall inspection can be effected relatively quickly to enable the fabrication personnel to identify defects caused by any process or equipment, and to immediately correct the cause for such defects.

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Page 3, please amend the third full paragraph as follows:

According to a further feature of the invention, the first examining phase is effected by generating a first flow of N different streams of data representing the pixels of different [images] views of the inspected pattern unit; generating a second flow of N different streams of data representing the pixels of different [images] views of the reference [pattern unit]; and comparing the data of the first flow with the data of the second flow to provide an indication of the suspected locations of the inspected [pattern unit] surface of the article having a high probability of a defect.

IN THE CLAIMS:

Claims 1-95 are canceled.

Claims 96-105 are added as new claims.